

CLAIMS

What is claimed:

1. A semiconductor device comprising:
 - 5 a semiconductor substrate;
 - a first electrode formed over the semiconductor substrate;
 - a first conductive smoothing layer formed over the first electrode,
wherein the first conductive smoothing layer has a surface roughness
less than that of the first electrode;
 - 10 a dielectric layer formed on the first conductive smoothing layer; and
 - a second electrode formed over the dielectric layer.
2. The semiconductor device of claim 1, further comprising:
 - a second conductive smoothing layer formed between the dielectric layer
15 and the second electrode, wherein the second conductive smoothing
layer has a roughness less than that of the second electrode.
3. The semiconductor device of claim 2, wherein the second conductive
smoothing layer comprises a refractory metal.
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4. The semiconductor device of claim 1, wherein the first electrode comprises a
first layer comprising a metal and a second layer comprising a refractory nitride
and the second electrode comprises a metal.
- 25 5. The semiconductor device of claim 1, wherein the first electrode and the
second electrode comprise a refractory nitride.

6. The semiconductor device of claim 5, wherein the refractory nitride comprises a material selected from the group consisting of titanium nitride and tantalum nitride.

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7. The semiconductor device of claim 5, wherein the first conductive smoothing layer comprises titanium.

8. The semiconductor device of claim 1, wherein the dielectric layer comprises
10 a high dielectric constant material.

9. The semiconductor device of claim 1, wherein the first electrode, the first conductive smoothing layer, the dielectric layer and the second electrode are part of a metal-insulator-metal (MIM) capacitor.

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10. The semiconductor device of claim 9, further comprising:
a capping layer over the first electrode, wherein the capping layer
comprises a refractory nitride and the first electrode comprises a
metal.

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11. A semiconductor device comprising:
a conductive layer;
a smoothing layer formed in contact with the conductive layer, wherein the
smoothing layer has a surface roughness less than that of the conductive
25 layer; and
a dielectric layer formed in contact with the smoothing layer.

12. The semiconductor device of claim 11, wherein the conductive layer comprises a metal.
- 5 13. The semiconductor device of claim 12, wherein the conductive layer comprises titanium nitride and the smoothing layer comprises titanium.
14. The semiconductor device of claim 11, wherein the conductive layer, the smoothing layer and the dielectric layer are part of a device selected from
10 the group consisting of a transistor and a capacitor.
15. The semiconductor device of claim 11, wherein the conductive layer comprises a first layer comprising a metal and a second layer comprising a refractory nitride.
- 15 16. The semiconductor device of claim 11, wherein the dielectric layer is a high dielectric constant material.
17. A semiconductor device comprising:
- 20 a semiconductor substrate;
a first electrode formed over the semiconductor substrate, wherein the first electrode comprises a first layer comprising metal and a second layer over the first layer, wherein the second layer comprises a refractory nitride;
- 25 a first smoothing layer formed over the first electrode, wherein the first smoothing layer comprises a refractory metal;

a dielectric layer formed on the first smoothing layer; and
a second electrode formed over the dielectric layer, wherein the second
electrode comprises a third layer comprising a refractory nitride and a
fourth layer over the third layer, wherein the fourth layer comprises a
metal.

18. The semiconductor device of claim 17, wherein the refractory nitride
comprises a material selected from the group consisting of titanium nitride and
tantalum nitride.

19. The semiconductor device of claim 18, wherein the refractory metal
comprises titanium.

20. A method for forming semiconductor device comprising:

providing a semiconductor substrate;
forming a first electrode formed over the semiconductor substrate;
forming a first conductive smoothing layer formed over the first
electrode, wherein the first smoothing layer has a surface roughness
less than that of the first electrode;

forming a dielectric layer formed on the first smoothing layer; and
forming a second electrode formed over the dielectric layer.